Aggregate Report AR88-13

Sand and Gravel Resources in the Flin Flon-Cranberry Portage Area

By H.D. Groom

Manitoba
Energy and Mines
Mines Branch

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Geological Services

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By H.D. Groom
Winnipeg, 1989

Energy and Mines

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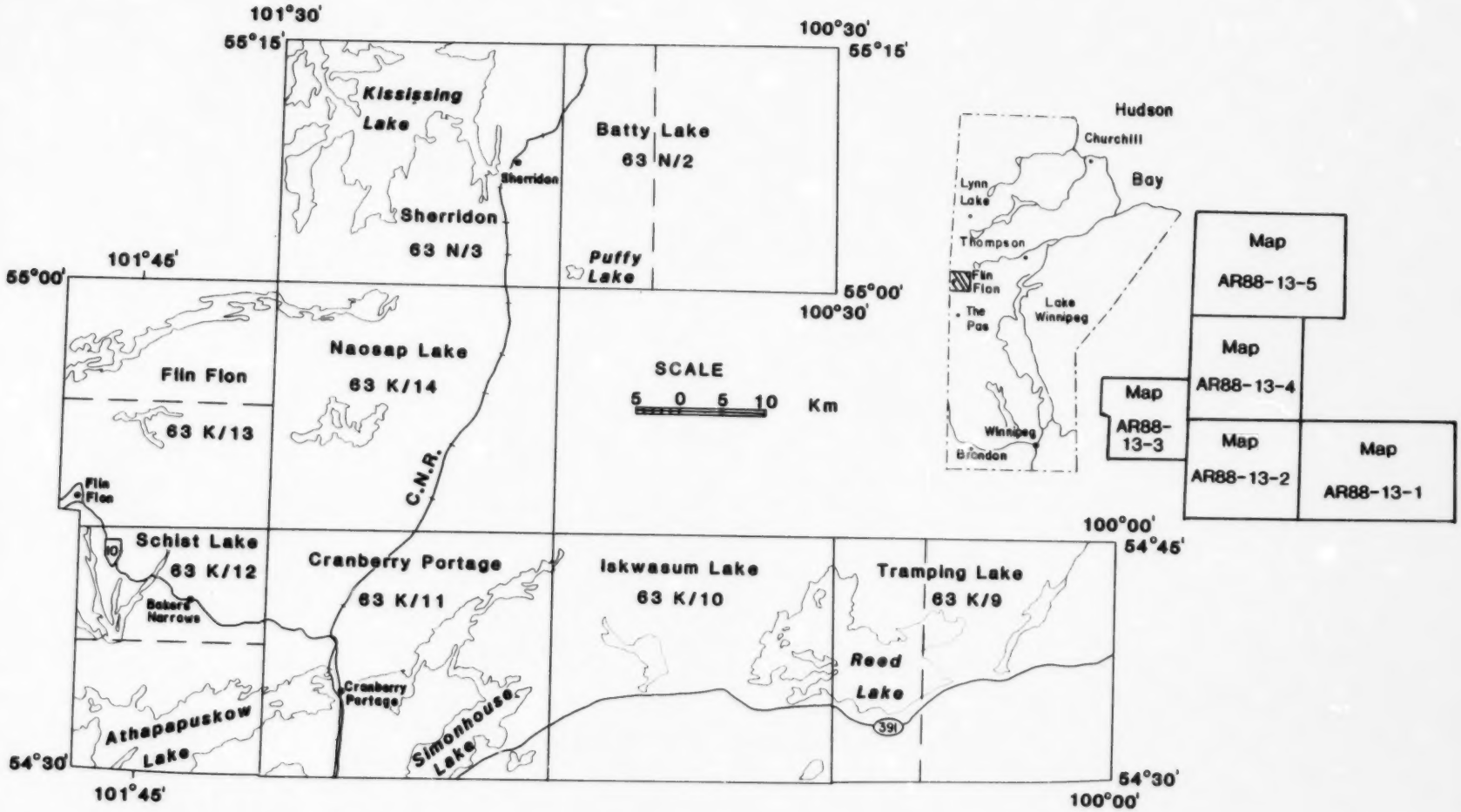

Figure 1: Location map of the Flin Flon-Cranberry Portage area.

INTRODUCTION

Objectives

An aggregate resource inventory was carried out during the summer of 1986 in the Flin Flon-Cranberry Portage area in order to: 1) delineate the sand and gravel resources at a scale of 1:50 000; and 2) provide an estimate of the aggregate reserves in the area. The information is used to provide aggregate users with resource information and to facilitate land-use planning designed to protect high quality aggregate deposits from sterilization.

Regional till sampling was also undertaken, as part of a program in conjunction with E. Nielsen (Geological Services Branch), to outline the Quaternary history of the area (Nielsen and Groom, 1989).

Location and Access

The Flin Flon-Cranberry Portage area is located in northwestern Manitoba (approximately 800 km from Winnipeg), (Fig. 1). It lies within eight 1:50 000 map sheets: 63K/9-14 and 63N/2-3 (Fig. 2).

The economic base of the region includes mining, forestry and tourism. The three major service centres, Flin Flon, Cranberry Portage and Sherridon, are accessible by road and rail line. The majority of the area is accessible only by boat or foot traverse, but a developed network of forestry trails provides access to many areas lying off the main roads.

Physiography

Elevations above sea level range from 335 m in the north to 290 m in the south. Relief is generally low to moderate and numerous lakes and swamps cover much of the terrain.

Drift cover is patchy on the Precambrian terrane; the bedrock surface has been glacially streamlined and whalebacks and drumlinoid ridges are common. Local relief in places exceeds 10 - 15 m. Drift cover is thicker and more extensive over the Paleozoic terrane. However, there are many areas where bedrock is close to surface. Paleozoic strata are flat lying and relief is low.

The region is drained by three major water systems. In the southwest, water flows through Goose River to the Saskatchewan River system, in the north flow is into the Burntwood River system and, in the south central and eastern area it is through the Grass River system.

Methodology

Surficial deposits were delineated on 1:50 000 scale air photos. Because the area is large and the survey was preliminary in nature, only those deposits accessible by road, trail and rail line were examined during field mapping.

Gravel pits, road cuts and natural exposures were examined during the first part of the field investigation. This was followed by a backhoe program to test the extent, depth and quality of identified aggregate deposits.

Aggregate samples were processed in two stages. In the field, samples that weighed between 75 and 100 kilograms were passed through 3" (7.5 cm), 1½" (3.8 cm) and ¾" (1.9 cm) screens. The weights of the 1½", ¾" and the less than ¾" fractions were recorded and a representative sample of the <¾" fraction was sent to Winnipeg for further sieve analysis. Sieve intervals used are shown in Appendix A.

Pebble counts of the ¾" -1½" fraction were done by subdividing the sample into Paleozoic carbonate and Precambrian intrusive, volcanic and metamorphic lithologies. The degree of deleterious factors, such as concretions or weathered pebbles, was noted.

During the winter of 1986, all gravel deposits were delineated on 1:50 000 scale air photos and these used to produce the 1:50 000 scale maps accompanying this report (Maps AR88-13-1 to 13-5).

Deposit reserves were obtained by multiplying area by proven aggregate depths; sterilization and depletion factors were taken into account. Detailed information for each aggregate deposit and sample grain size data are filed on the Aggregate Resources Section computer system; these data are available upon request.

Previous Work

The surficial geology of part of the area has been mapped by Singhroy (1977). The aggregate deposits and the Quaternary geology of the area immediately south of the present study were reported on by Singhroy and Werstler (1980).

The bedrock geology has been mapped by various workers at varying scales (see Manitoba Energy and Mines Index Maps 7, 7A and 8, 1985). The regional geology was compiled by Bailes (1971). Richardson and Ostry (1987) present a more recent summation of the lithology and geological setting of the supracrustal rocks. Both works have extensive bibliographies.

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Grant Zimmerman provided able field assistance. Lidia Ghobrial, Cartographic Services, drafted the maps and figures. Shirley Weselak typed the manuscript. The manuscript was reviewed by staff members of the Aggregate Resources Section and the Department's editor.

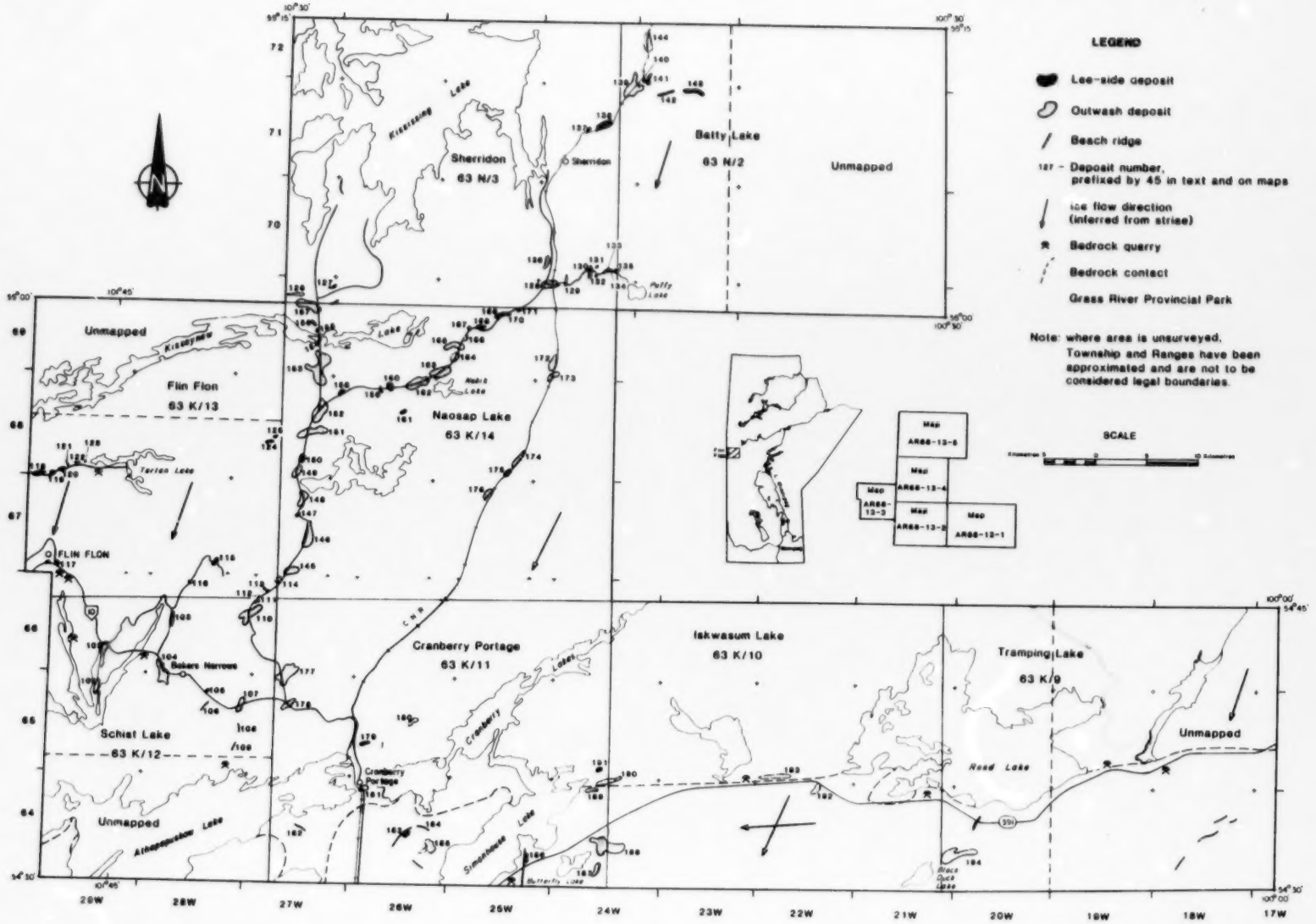


Figure 2: Location map showing deposits and map sheet areas.

GEOLOGY

Bedrock Geology

The bedrock in the Flin Flon-Cranberry Portage area is Precambrian and Paleozoic in age. The Precambrian terrane comprises the Flin Flon-Snow Lake greenstone belt in the south and the Kisseynew metasedimentary gneiss belt in the north. The Red River Formation composes the Paleozoic strata. The areal distribution of the bedrock is shown in Figure 3.

The Flin Flon-Snow Lake greenstone belt consists mainly of mafic to felsic volcanic rocks of the Amisk Group and sandstone and conglomerate of the overlying Missi Group. These supracrustal rocks have been intruded by granitoid rocks that underlie large areas of the belt. The Kisseynew gneiss belt comprises greywacke and mudstone-derived gneisses, and migmatites of the Burntwood River metamorphic suite; the Missi metamorphic suite is primarily quartzo feldspathic gneiss metamorphically derived from sandstone. The area has undergone regional metamorphism and deformation of varying intensity.

The Ordovician Red River Formation unconformably overlies Precambrian rocks at the south margin of the area (Fig. 3). The formation is 20 - 30 m thick and is composed of variously fossiliferous dolomite. The lower part of the formation is arenaceous. The contact between Precambrian and Paleozoic bedrock is irregular; in the east it is characterized by north-facing cuestas 5 - 10 m high.

Surficial Geology

The results of the till geochemical study and an outline of late glacial events in the region are presented in Groom and Nielsen (1987) and Nielsen and Groom (1989).

The sequence of glacial events was:

1. dominant ice flow to the south and southwest (190° - 220°) with the most southerly flow occurring in the western part of the area;
2. ice retreat followed by a westerly ice advance (270°) in the extreme south central and eastern part of the map area; and
3. expansion of Lake Agassiz into the area as the ice retreated northward and final withdrawal of Lake Agassiz.

Till deposits on the Precambrian terrane are generally found on the down-ice side of bedrock knolls. The till has a sandy matrix and the lithology of the pebble fraction is 100% Precambrian. Till cover on Paleozoic bedrock is more continuous than on Precambrian bedrock and most commonly it is 1 - 3 m thick. The till matrix and pebble lithology become progressively more calcareous southward from the Palezoic contact. This change is gradual in the west part of the study area but more abrupt in the east where ice overriding the north facing Paleozoic escarpments resulted in rapid incorporation of carbonate bedrock into (Fig. 4). The westerly ice advance, that affected the southeast and central part of the area, deposited a silty till with pebble lithology of 80 - 95% carbonate rock types.

Lee-side aggregate deposits (map unit 1, this report) are the result of infilling of large cavities formed in the ice on the lee-side of bedrock knolls. The combination of sorted material deposited by intermittent streams and unsorted material released from the roof and walls of the cavity results in a complex interbedding of sand and gravel, silt and clay, diamicton and isolated cobbles and boulders throughout the deposit. Deposit depth and areal extent is dependant upon the size of the cavity and varies greatly between deposits.

Glaciofluvial deposits (map unit 2, this report) in the Flin Flon-Cranberry Portage area are primarily outwash fans formed where meltwater streams flowed from the ice into Lake Agassiz. A simple fan consists of a coarse gravel apex, deposited at the ice front, and a distal portion composed of sand. The gravel facies is commonly overlain by sand deposited as the ice front retreated. The upper metre of these sands was reworked by Lake Agassiz, the contact frequently being marked by an upward change in grain size.

Lacustrine deposits form a minor component of the surficial material. Clay deposits are of limited areal extent and usually less than 2 m thick; commonly they are rhythmically bedded. Beach ridges are infrequent on the Precambrian terrane but occur as well developed deposits on Paleozoic strata. These deposits comprise 1 - 2 m of sandy fine pebble gravel that overlies till or stony lake clay.

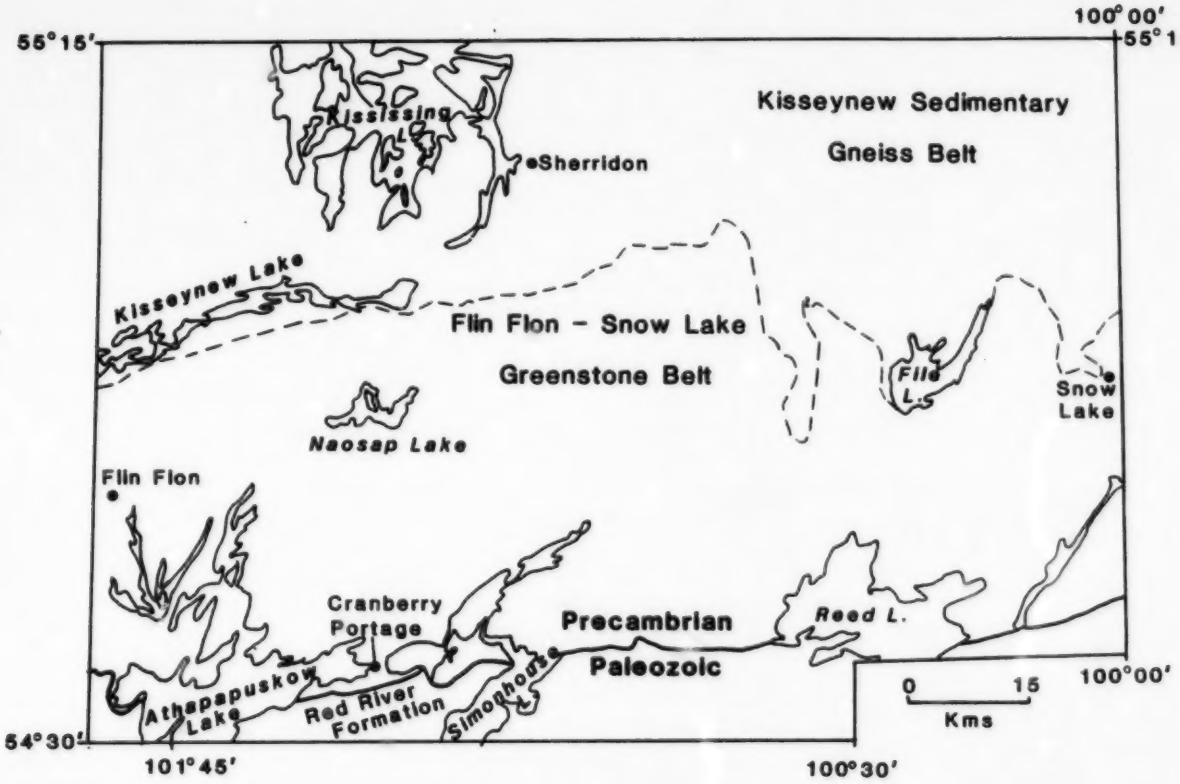


Figure 3: Generalized bedrock geology (modified from Bailes, 1971).

Figure 4: Carbonate bedrock incorporated into Precambrian derived till; Reed Lake quarry, Twp. 64, Rge. 21W.

AGGREGATE RESOURCES

Introduction

The sand and gravel resources in the Flin Flon-Cranberry Portage area are found in glacial (lee-side), glaciofluvial and glaciolacustrine deposits. Of these, the glaciofluvial deposits contain more than 90% of the area's aggregate reserves.

Deposit and sample locations are shown on Maps AR88-13-1 to 13-5 (in pocket). Table 1 summarizes relevant information for each of the deposits. Table 2 summarizes grain size data for all samples; more detailed sieve results are given in Appendix A. Backhoe test pit logs and gravel pit descriptions are given in Appendix B. Pebble lithology of the ¾" - 1½" (1.9 - 3.8 cm) fraction and percent deleterious material in each sample is given in Appendix C. Appendix D shows the size limits of granular descriptive terms (e.g. sandy fine pebble gravel) used in the text and tables.

Deposit locations given in the text are in the township-range system; for example the southwest quarter of section 3, township 68, range 29 west is abbreviated to SW 3-68-29W.

Aggregate Deposits

Lee-side deposits (map units 1a and 1b)

These deposits are scattered across the Precambrian terrane. Due to the nature of their formation, they are of variable depth and limited areal extent. The material that composes these deposits varies from diamicton and boulders to beds of gravel, sand, silt and clay. For these reasons lee-side deposits are marginal sources of aggregate in the Flin Flon-Cranberry Portage area.

Several of these deposits, however, have been utilized for road construction in areas without other sources of sand and gravel. The deposits used for construction of the Tartan Lake road (Twps. 67 and 68-29W) are of this type. Figure 5 shows a typical lee-side deposit (sec. 3-68-29W).

Glaciofluvial deposits (map units 2a and 2b)

Glaciofluvial deposits are found throughout the study area. Most are outwash fans composed primarily of sand and in most the thickness of sand exceeded the 4 m depth of the backhoe test pits. The gravel facies in this type of deposit is usually overlain by thick beds of sand, but where the gravel facies outcrops it is extensively mined and is the major source of high quality sand and gravel for the area (Fig. 6).

Deposit 45146 (Map AR88-13-4) secs. 14 and 23-67-27W) has more than 6 m of pebble gravel at the northern apex. Southward the gravel thins rapidly to less than 1 m and overlies sand. The southern part of the deposit consists of more than 4 m of crossbedded sand. The material in the active pit, located in SE23-67-27W, is used for road maintenance.

Deposit 45152 (Map AR88-13-4 secs. 24 and 25-68-27W) has at least 6 m of poorly sorted pebble and cobble gravel and well sorted beds of coarse sand and granules at its northern end; gravel continues below the water table at a depth of 6 m. The deposit fines southward where sand overlies bedrock to the west and till to the east. This deposit has been extensively mined and the large pit in SE25-68-27W was active in 1986.

Deposit 45162, north of Nikik Lake (Map AR88-13-4 Twps. 68 and 69, Rges. 25W and 26W), is primarily sand and fine pebble gravel. Pit depths are limited by the water table at less than 2 m. The exception is the pit in NW36-68-26W, which is 4 m deep and has a high percentage of coarse pebble and fine cobble gravel. This pit was active during the summer of 1986. The material was used to upgrade the Sherridon road.

Deposit 45130 (Map AR88-13-5 sec. 4-70-24W) is small but was the major source of aggregate used to build the Puffy Lake road. The best quality material in this deposit has been removed. Reserves remain in the north of the deposit where 2 m of fine pebble gravel overlie 3 m of cobbley coarse pebble gravel and in the south where 2.5 m of very sandy pebble gravel overlie sand.

Deposit 45194 (Map AR88-13-1 secs. 16 and 17-64-20W) has been mined to depletion at its eastern end. Recently the pits to the west have been active and there are large stockpiles on site. The pits expose 3 m of well sorted sand and pebble gravel and gravel reserves continue below the water table at 3 m. Backhoe pits in the unopened portion of the deposit reveal 2.5 m of pebble gravel that overlie sand.

Deposit 45188 (Map AR88-13-1 and 13-2 secs. 14 to 17-64-24W) is composed primarily of sand with local gravel pockets. Several small pits in the gravel pockets show 2 to 3 m of well sorted pebble gravel. Pit depths are limited by the water table; the water table was not present in the pit in SW15-64-24W. The pit exposed 4 m of sandy coarse pebble gravel that overlies 1 m of sand that, in turn cover stone-free clayey silt. Backhoe test pits indicate the gravel thins rapidly outward from the central area of gravel pockets. Most reveal less than 2 m of gravel overlying sand.

Beach Deposits (map units 3a and 3b)

Beach ridges constitute a minor component of the aggregate resources of the area. They occur in the south and overlie Paleozoic bedrock. None are currently utilized for extraction of gravel. The two best developed beach deposits flank till-capped bedrock hills.

Deposit 45186 (Map AR88-13-2 sec. 2-64-25W) consists of two beach levels, one 2.5 m higher in elevation than the other. Both ridges consist of less than 2 m of well sorted sandy fine pebble gravel that overlies silt and clay. The clast lithology is 85% carbonate rocks. Littoral sand covers the area between ridges.

TABLE 1

AGGREGATE DEPOSITS IN THE FLIN FLON-CRANBERRY PORTAGE AREA

Deposit Number	Genetic Type	Site Number	Pit Status	Percent Stone (+#4) (+4.76 mm)	Lithology % Precambrian	Lithology % Carbonate	Estimated Reserves (000 m^3)	Comments
45101	glaciofluvial	HG890	abandoned	47	100	-	111.5	pit revegetated; pebble gravel and sand in north part of deposit.
45102	glaciofluvial	HG891 HG892	abandoned intermittent	40	100	-	226.2	deposit flanks bedrock; material ranges from gravel to silt. Gravel in most pits has been removed, predominantly sand remaining.
45103	glaciofluvial	HG887	intermittent	5	100	-	212.0	deposit primarily sand; local gravel pockets; pits to north are beginning to revegetate.
45104	glaciofluvial						17.5	deposit is sand; sterilized by location of airport and cottage development.
45105	lee-side	HG886	intermittent				16.0	flanking bedrock; pit 12 m deep, near depletion; gravel in upper 2 m.
45106	beach	HG885	intermittent	20	100	-	44.1	pit is 1.5 m pebble gravel over sand; garbage dump at north end of deposit.
45107	glaciofluvial		abandoned				114.3	deposit is sand over bedrock; largely sterilized by Hwy. 10 and campground.
45108	beach						14.8	pebbly sand.
45109	beach						3.6	sand, isolated gravel lenses.
45110	glaciofluvial	HG896 HB597 HB598	intermittent	63	100	-	1 399.9	pit recently active; northern part of deposit. predominantly sand with some pebble beds.
45111	glaciofluvial	HG857	intermittent				7.4	pit near depletion; 2 m very sandy fine pebble gravel.
45112	glaciofluvial						6.6	sand.
45113	glaciofluvial	HB599	intermittent				80.1	pit at road is depleted; HB599 is 3.5 m pebble gravel and sand over bedrock; deposit is sand over bedrock to the west.
45114	glaciofluvial	HG876	abandoned				25.0	pit depleted; remaining reserves are 2-3 m fine sand.
45115	lee-side	HG888	intermittent				37.2	garbage dump at south end of deposit; HG888 is near depletion; 1-2 m sandy coarse pebble gravel at south end of pit.
45116	lee-side						7.5	some gravel at north end; deposit largely sterilized by road.
45117	lee-side	HG889	intermittent				29.6	deposit flanks bedrock; material of varying thickness; predominantly sand, some gravel and clay pockets.
45118	lee-side	HG894 HG907	intermittent intermittent	11.6	100	-	132.5	deposit flanks bedrock; up to 10 m deep; material variable, pockets of coarse cobble gravel, sand and silt. Deposit largely depleted.

45119	lee-side							6.0	deposit flanks bedrock; less than 2 m pebble gravel.
45120	lee-side	HG908	intermittent					66.7	deposit flanks bedrock; variable depths up to 3 m; predominantly fine sand; overlain by clay.
45121	lee-side	TP067						19.2	deposit flanks bedrock; variable depths; material is sand, pebble gravel and cobbles.
45122	lee-side	HG895 TP068	intermittent					50.0	pit near depletion; variable depths and material; predominantly coarse gravel.
45123	lee-side							10.0	pit near depletion; variable depth and material; flanking bedrock.
45124	glaciofluvial							37.0	shallow pebble gravel over bedrock.
45125	glaciofluvial							37.0	1-2 m pebble gravel over bedrock.
45126	glaciofluvial							235.0	up to 3 m sand over bedrock; occasional pockets of fine pebble gravel.
45127	lee-side	HG898	intermittent	46	100	-		259.0	pit not used recently; deposit about 5 m high flanks bedrock. Material is coarse pebble gravel with cobbles.
45128	glaciofluvial	HG858						552.9	backhoe pit displays more than 3 m of medium sand, isolated beds of pebbly sand.
45129A	glaciofluvial							15.2	sand over bedrock.
45129B	glaciofluvial							24.8	sand over bedrock.
45130	glaciofluvial	HG884A	intermittent	19	100	-		86.4	large active pit (HG884); deposit is more than 6 m
		HG884B		47	100	-			thick, material ranges from cobble gravel to sand.
		HB627		42	100	-			Much of the best quality material has been removed.
		HB628		28	100	-			
		HB629							
		HB630	intermittent						
45131	lee-side							7.5	roadcut; deposit flanks bedrock; primarily sand remaining.
45132	lee-side							8.8	roadcut; flanks bedrock; some coarse gravel remains.
45133	lee-side	HG883	intermittent	45	100	-		15.0	deposit flanks bedrock; more than 4 m of sandy pebble gravel; material variable from cobbles to granules; near depletion.
45134	lee-side							3.7	roadcut; some pebble gravel over till.
45135	lee-side							3.4	roadcut; near depletion.
45136	glaciofluvial							180.0	predominantly sand; minor pebble gravel at north end.
45137	lee-side							39.4	on rail line; untested.
45138	glaciofluvial							92.0	primarily sand; pit not recently used.
45139	glaciofluvial							1 416.0	large shallow deposit [illegible] bedrock; predominantly sand, some pockets of fine gravel; no recent use.
45140	glaciofluvial							106.3	on rail line; sand exposed in cuts.
45141	lee-side	HG914	intermittent	64.7	100	-		119.7	flanks bedrock; pit 5 m deep - material variable from cobble gravel to clay; no recent use.

Deposit Number	Genetic Type	Site Number	Pit Status	Percent Stone (+#4) (+4.76 mm)	Lithology % Precambrian	Lithology % Carbonate	Estimated Reserves (000 m^3)	Comments
45142	lee-side						48.7	shallow deposit over bedrock; depleted of gravel, primarily sand remains.
45143	lee-side						53.9	shallow deposit over bedrock; three small pits have been abandoned; some gravel remains.
45144	glaciofluvial						45.7	pit depleted; deposit is pebble gravel in north and sand at south end.
45145	glaciofluvial	HB600					661.9	deposit is more than 3.5 m coarse sand; some granular size material.
45146	glaciofluvial	HG902	intermittent	42	100	-	623.4	deposit is more than 3 m of sand in the south half and gravel in the north; active pit at north end has more than 6 m very sandy fine pebble gravel; HG902 exceeds 3 m sandy coarse gravel.
		HB603	intermittent	16	100	-		
		HB604						
		HB605						
		HB653	intermittent	7	100	-		
45147	lee-side	HG877	abandoned				6.2	pit depleted; some very sandy, fine pebble gravel left at north end.
45148	glaciofluvial						402.4	deposit is sand; sterilized by campground east of road.
45149	glaciofluvial						149.6	pit depleted of gravel; remaining material is sand.
45150	lee-side						61.0	shallow; sandy pebble gravel over bedrock.
45151	glaciofluvial	HB606					4 000.2	deposit is variable in depth and material; 1-2.5 m pebble gravel overlies sand, till or bedrock west of road; there is up to 4 m
		HB607						
		HB608						
		TP084	abandoned					sand and local gravel pockets east of road.
45152	glaciofluvial	HG903A	intermittent	51	100	-	635.8	deposit is greater than 5 m gravel at north end; in south, material is finer and shallower.
		HG903B		35	100	-		
		HB610						
		HB611						
		HB612		51	100	-		
		HB634						
		HB635	intermittent					
		TP085						
45153	glaciofluvial	HB613					3 537.8	sand; 1 to more than 3 m over bedrock.
		HB614						
		HB615						
		HB633						
45154	lee-side		abandoned				30.9	depleted pit; remaining material is sand.
45155	glaciofluvial	HB632					80.5	sand; pits depleted of gravel.
45156	glaciofluvial						131.5	sand; pit east of road depleted of gravel.
45157	glaciofluvial	HG897	intermittent	29	100	-	345.0	large pit by road is very shallow, little gravel remaining; small pit (897) is less than 2 m deep, very sandy fine pebble gravel limited by water table.

45158	lee-side						39.5	predominantly sand remaining.
45159	lee-side						62.0	sand; pit east of creek is depleted gravel over bedrock.
45160	lee-side	HG899	intermittent	40	100	-	81.4	flanks bedrock; more than 3 m poorly sorted gravel material shallower at north end.
45161	glaciofluvial	HB616 HB617					346.0	deposit is exceeds than 3.5 m sand.
45162	glaciofluvial	HG900 HB618 HB619	intermittent	26	100	-	631.0	deposit predominantly sand; coarse gravel at west edge (HG900).
45163	glaciofluvial	HG901 HG904 HB620 TP086	intermittent	23 36	100 100	-	638.1 -	pit recently active; pebble gravel; extraction limited by water table; eastern part of deposit exceeds 4 m interbedded sand and pebble gravel north of road and is predominantly sand south of road.
45164	glaciofluvial		abandoned				39.6	pit depleted; reserves of sand and potential gravel to west, over bedrock.
45165	glaciofluvial	HB621 HB622 HB623					597.0	more than 3 m sand over bedrock.
45166	glaciofluvial	HG905		5	100	-	14.7	deposit is 1 m pebble gravel over sand at north end, unopened to south.
45167	lee-side	HG852					21.6	1 - 2 m coarse pebble gravel.
45168	lee-side	HG853					79.2	sand exposed in roadcuts; less than 1 m of sandy fine pebble gravel at 853.
45169	lee-side	HG854					73.5	predominantly sand, some fine pebble gravel.
45170	lee-side						57.4	sand exposed in roadcuts.
45171	lee-side	HG906	intermittent	31	100	-	56.4	pit depth is from 3 - 5 m; material varies from silty clay to cobble beds, some good pockets of pebble gravel.
45172	glaciofluvial	HG913	intermittent	30	100	-	74.3	pit is beginning to revegetate; 4 - 5 m sandy pebble gravel.
45173	glaciofluvial						42.6	unopened; shallow pebble gravel overbedrock; high sand content.
4517	glaciofluvial	HG855					46.0	on rail line - variable sand and minor pebble gravel.
45175	glaciofluvial	HG917		16	100	-	7.4	rail line cut exposes 2 m very sandy fine pebble gravel and coarse sand.
45176	lee-side	HG856					5.0	rail line cut exposes less than 1 m coarse gravel and boulders.
45177	glaciofluvial	HB593 HB594 HB595 HB596 HB636 HB637			100	-	813.0	two depleted roadside pits; unopened portionis predominantly sand; at HB595, pebble gravel lies below water table (3 m).

Deposit Number	Genetic Type	Site Number	Pit Status	Percent Stone (+#4) (+4.76 mm)	Lithology % Precambrian	Lithology % Carbonate	Estimated Reserves (000 m^3)	Comments
45178	glaciofluvial	HG909	intermittent	28	100	-	410.4	active pit is 7 m deep - interbedded sand and fine pebble gravel. Deposit north of road is primarily sand and/or sterilized by road. Cottages at south end of deposit.
45179	lee-side	HG881	intermittent				15.6	variable material deposited against bedrock; depths from 5 - 8 m. Material ranges from areas of clay to gravel and cobble beds. Pit nearly depleted of gravel sized material.
45180	glaciofluvial	HG916	intermittent	23	100	-	48.4	pit near depletion; some pebble gravel but primarily coarse sand remains.
45181	glaciofluvial	HG878 HG879	abandoned	25	96	4	127.9	two pits, both beginning to revegetate. Deposit is predominantly sand with pockets of gravel. Beach sediments of less than 1 m pebble gravel overlie part of deposit.
45182	beach	HG862	abandoned	32	100	-	17.6	deposit less than 3 m pebble gravel to till base; some material remains north and south of pit.
45183	beach	HG880 HB550 HB551	intermittent	14	96	4	306.8	deposit largely depleted in south; reserves of 1 - 2 m pebble gravel in ridge north of large, inactive glaciofluvial pit (HG880).
		HB552 HB555		52	72	28		
45184	beach	HB553 HB554					157.3	predominantly sand; 2.5 m gravel at site HB553
45185	glaciofluvial	HB557 HB558 HB559 HB560					603.0	deposit is predominantly sand. Beach sediments of (less than 1 m fine pebble gravel overlie part of deposit.
45186	beach	HG866 HG866A HB562 HB588	abandoned	42	5	95	311.8	deposit south of PR391 consists of two beach levels; in each, less than 2 m pebble gravel overlies sand and/or clay. North of road, deposit sterilized by location of bible camp. Large depleted pit (866A) contains glaciofluvial material.
		HB589 HB589A HB590 HB591 HB592 TP078 TP082		26	15	85		

		TP082						
		TP083						
45187	glaciofluvial	HB574					148.0	unopened deposit; 3 m fine sand.
		HB575						
45188A	glaciofluvial	HG868	intermittent	53	9	91	450.8	deposit is 2 - 5 m interbedded pebble gravel and sand; extraction depth limited by water table.
		HB576						
		HB577		34	10	90		
45188B	glaciofluvial	HG870	intermittent	40	22	78	420.0	sandy pebble gravel up to 6 m thick (HG870); backhoe pits reveal 2 - 3 m interbedded sand and pebble gravel over sand for rest of deposit.
		HB565						
		HB568						
		HB569						
45188C	glaciofluvial	HB564					4 554.0	predominantly sand; some pockets of pebble gravel that are usually coincident with water table.
		HB566						
		HB567						
		HB570		52	41	59		
		HB571						
		HB572						
		HB573						
45189	glaciofluvial	HB581		47	93	7	321.5	unopened deposit; more than 3 m very coarse cobbel gravel overlain by less than 1 m sand.
		HB582						
		HB583						
45190A	glaciofluvial	HG875	intermittent	48	94	6	107.6	up to 4 m interbedded gravel and sand. Pits have not been used recently.
		HB578						
		HB579						
		HB580						
45190B	glaciofluvial	HB584					1 230.5	deposit shallow over bedrock; variable depths of sand over clay or till; some lag gravel at surface.
		HB585						
		HB586						
		TP081						
45191	glaciofluvial	HB587					49.0	3 m interbedded sand and granules.
45192	glaciofluvial	HG910	intermittent				66.9	small pit shows more than 2 m medium sand. West end of deposit sterilized by campground.
45193A	glaciofluvial						62.5	greater than 3 m medium sand.
45193B	glaciofluvial	HG858	abandoned				61.7	predominantly sand; pit is near depletion, some fine pebble gravel left.
45194A	glaciofluvial	HB642					4 933.6	sand, usually over clay or till; local pockets of gravel (less than 1.5 m thick) at surface.
		HB643						
		HB645						
		HB646						
		HB647						
		HB648						
		HB649						

Deposit Number	Genetic Type	Site Number	Pit Status	Percent Stone (+#4) (+4.76 mm)	Lithology % Precambrian	Lithology % Carbonate	Estimated Reserves (000 m^3)	Comments
45194B	glaciofluvial	HG860	intermittent	62	9	91	1 527.5	several large pits. East end of deposit is near depletion and used as a dump. Active pit (HG860) has large stockpiles - gravel continues below water table. There are more than 3 m interbedded gravel and sand at west end, but limited by water table.
		HG911	abandoned	60	38	62		
		HG912	intermittent	38	69	21		
		HB638		50	12	88		
		HB638A						
		HB639						
		HB644						
45194C	beach	HB640						
		HB641	abandoned				80.3	one small pit; deposit is less than 2 m pebble gravel over till.
				TOTAL RESERVES			34 429.7	

TABLE 2

GRAIN SIZE DISTRIBUTION OF GRAVEL SAMPLES

Deposit Number	Sample Number	% Gravel (> # 4) (> 4.76 mm)	% Sand 4.76 mm - 0.07 mm	% Silt and Clay < 0.07 mm	Crushable on Site + (Yes)
45101	HG890	47.2	50.9	1.9	
45102	HG892	39.6	54.8	5.6	
45103	HG887	5.0	93.5	1.5	
45106	HG885	20.2	77.1	2.9	
45110	HG896	63.4	33.8	2.8	x
45118	HG894	11.6	85.6	2.8	x
45127	HG898	45.7	53.3	1.0	x
45130	HG884A	19.0	80.6	0.4	x
	HG884B	46.9	52.8	0.3	x
	HB627	41.8	57.5	0.7	
	HB628	28.4	70.4	1.4	
45133	HG883	44.7	53.1	2.2	x
45141	HG914	64.7	33.9	1.4	x
45146	HG902	42.4	57.1	0.5	
	HB603	16.2	83.2	0.6	
	HB653	7.4	91.9	0.7	
45152	HG903A	50.7	47.4	1.9	x
	HG903B	34.9	63.8	1.3	
	HB612	50.6	46.0	3.4	
45157	HG897	29.1	70.0	0.9	
45160	HG899	40.2	55.8	4.0	x
45162	HG900	25.5	71.9	2.6	x
45163	HG901	22.8	73.8	3.4	
	HG904	35.7	63.6	0.7	x
45166	HG905	4.9	91.2	3.9	
45171	HG906	30.9	68.5	0.6	
45172	HG913	30.0	69.7	0.3	
45175	HG917	15.9	83.4	0.7	
45178	HG909	27.5	71.9	0.6	
45180	HG916	23.4	75.4	1.2	
45181	HG879	25.2	72.2	2.6	
45182	HG862	32.3	57.5	10.2	x
45183	HG880	14.2	83.6	2.2	x
	HB552	52.1	42.8	5.1	
45186	HG866	42.1	55.1	2.8	
	HB589	26.3	70.6	3.1	
45188A	HG868	53.0	45.1	1.9	
	HB577	33.8	64.5	1.7	
45188B	HG870	39.8	56.6	3.6	
45188C	HB570	52.2	43.2	4.6	
45189	HB581	46.9	48.9	4.2	x
45190A	HG875	48.2	47.8	4.0	
45194B	HG860	61.6	36.5	1.9	
	HG911	60.1	37.2	2.7	
	HG912	37.5	53.3	9.2	
	HB638	49.8	48.0	2.2	

Figure 5: Lee-side deposit along Tartan Lake road (sec. 3-68-29W).

Figure 6: Gravel facies of outwash deposit; sec. 25-68-27W.

The composition of the beach ridge, Deposits 45183 and 45184 (Map AR88-13-2) running through secs. 15, 22 and 23-64-26W is variable. In many places it is sand, but where it is composed of gravel, backhoe pits disclose pebble gravel that overlies stony lake clay. The pebble lithology is 28% carbonate rock. This deposit has been mined in the past and is near depletion in the SW 1/4 of sec. 15.

Bedrock Quarries

There are several bedrock quarries in the area as high quality gravel deposits are scarce.

The quarries in Precambrian bedrock are generally small; most are adjacent to Highway 10 and have produced material used for causeway riprap and construction of new segments of Highway 10 between Flin Flon and Cranberry Portage. The large quarry in sec. 2-65-28W produces railway ballast for the C.N.R.

Five quarries are in carbonate bedrock; all are past producers of crushed stone. The quarry in sec. 3-64-25W has recently been active and large stockpiles are present on site.

For further information concerning the suitability of the bedrock formations for aggregate production, see Jones, 1986 a and b. Production histories of quarries in the area are on file with the Exploration Services Section of the Manitoba Mines Branch.

Aggregate Supply

There are 36 429.6 x 10^3 cubic metres of aggregate reserves in the Flin Flon-Cranberry Portage area. Table 3 shows the reserve figures by deposit and material type.

TABLE 3

AGGREGATE RESERVES IN THE FLIN FLON-CRANBERRY PORTAGE AREA

Deposit Type	Sand and Gravel ('000 m^3)	Sand ('000 m^3)	Total ('000 m^3)
Lee-side	1 067.4	456.1	1 523.5
Glaciofluvial	12 608.1	21 361.8	33 969.9
Beach	760.6	175.7	936.3
TOTAL	14 436.1	21 933.6	36 429.7

Glaciofluvial deposits are the most common deposit type and they contain over 90% of reserves. Deposits were mapped as sand if gravel had not been reached at the bottom of 4 m backhoe pits, however, there is a high potential for gravel to be present at greater depths. Therefore, the figures in Table 3 probably underestimate the amount of gravel in these deposits.

Lee-side deposits are a marginal aggregate source and utilized only where no other source exists. They account for 4.1% of the reserves in the area.

There are very few beach deposits in the area; they contribute less than 3% of the aggregate reserves.

The total reserve figure appears high but the deposits are widely scattered over a large area and, in fact, the region is aggregate poor. Crushed bedrock is a suitable replacement for gravel, but it must be mixed with sand to meet most aggregate end uses. For this reason, the sand deposits in the Flin Flon-Cranberry Portage area are as important a resource as the high quality gravel deposits.

REFERENCES

Bailes, A. H.

1971: Preliminary compilation of the geology of the Snow Lake-Flin Flon-Sherridon area; Manitoba Mines Branch, Geological Paper 1/71, 27 p.

Groom, H.

1986: Aggregate resources in the Flin Flon-Cranberry Portage area; In Manitoba Energy and Mines, Minerals Division, Report of Field Activities, 1986, p. 223-225.

Groom, H. and Nielsen, E.

1987: Till provenance as it relates to the glacial history of The Pas-Flin Flon area, Manitoba; Geological Association of Canada, Program with Abstracts, v.12.

Jones, C. W.

1986a: The aggregate potential of selected Paleozoic and Precambrian rocks in Manitoba; Manitoba Energy and Mines, Aggregate Report AR86-1, 13 p.

1986b: Preliminary assessment of selected carbonate bedrock resources for aggregate potential; In Manitoba Energy and Mines, Minerals Division, Report of Field Activities, 1986, p. 226-228.

Manitoba Energy and Mines

1985: Geological index map of Manitoba showing geological maps and reports (revised periodically); Manitoba Energy and Mines, Geological Services Branch, Index Map Series 7.

1985: Geological index map of Manitoba showing preliminary geological maps (revised periodically); Manitoba Energy and Mines, Geological Services Branch, Index Map Series 7A.

1985: Geological index map of Manitoba showing geological maps (revised periodically); Geological Survey of Canada, Index Map Series 8 (refer to G.S.C. publications for more information).

Nielsen, E. and Groom, H.

1989: Trace element geochemistry and till provenance in The Pas-Flin Flon area, Manitoba; Manitoba Energy and Mines, Open File Report OF89-3, 20 p.

Richardson, D. J. and Ostry, G.

1987: Gold deposits of Manitoba; Manitoba Energy and Mines, Economic Geology Report ER86-1 91 p.

Singhroy, V.

1977: Quaternary geology of the Cranberry Portage area; Manitoba Mineral Resources Division, Preliminary Maps CP1 - 6.

Singhroy, V. and Werstler, R.

1980: Sand and gravel resources and Quaternary geology of The Pas region; Manitoba Department of Energy and Mines, Geological Report GR80-2, 60 p.

APPENDICES

APPENDIX A

Sample Sieve Data

Deposit Number	45101	45102	45103	45106	45110
Sample Number	HG890	HG892	HG887	HG885	HG896
[1]Crushable on Site	-	-	-	-	x
1 1/2 in.	96.2	96.8	100.0	100.0	86.8
3/4 in.	81.5	86.1	99.2	99.4	63.7
3/8 in.	67.5	75.1	98.3	92.6	50.5
#4	52.8	60.4	95.0	79.8	36.6
#8	36.6	42.3	88.5	67.9	25.1
#16	20.9	30.0	66.6	51.6	18.7
#30	10.0	18.2	36.7	35.8	14.8
#50	5.1	11.1	8.4	17.8	11.2
#100	3.3	8.0	2.7	8.7	7.3
#200	1.9	5.6	1.5	2.9	2.8
<200	0.0	0.0	0.0	0.0	0.0

Deposit Number	45118	45127	45130	45130	45130
Sample Number	HG894	HG898	HG884A	HG884B	HB627
Crushable on Site	x	x	x	-	-
1 1/2 in.	100.0	81.4	92.1	87.7	89.7
3/4 in.	98.8	70.7	89.0	74.6	81.4
3/8 in.	96.4	63.5	84.8	62.3	71.4
#4	88.4	54.3	81.0	53.1	58.3
#8	72.6	43.7	73.9	40.4	42.9
#16	54.3	29.7	57.3	23.3	23.6
#30	46.7	15.5	27.9	7.6	7.7
#50	40.1	4.9	7.9	1.7	2.6
#100	18.8	1.9	2.1	0.7	1.3
#200	2.8	0.9	0.4	0.3	0.7
<200	0.0	0.0	0.0	0.0	0.0

[1] cobbles larger than 10 cm
- not present
x present

Deposit Number	45130	45133	45141	45146	45146
Sample Number	HB628	HG883	HG914	HG902	HB603
Crushable on Site	-	x	x	-	-
1 1/2 in.	97.4	93.9	77.8	89.9	96.7
3/4 in.	87.0	81.1	55.0	78.4	92.8
3/8 in.	78.1	66.7	44.4	68.2	89.6
#4	71.6	55.3	35.3	57.6	83.8
#8	63.9	45.0	32.4	45.3	75.3
#16	50.4	35.6	28.6	32.2	61.3
#30	24.3	23.5	21.0	15.7	39.5
#50	5.1	10.8	9.5	5.2	10.5
#100	2.3	5.0	3.9	1.3	1.5
#200	1.4	2.2	1.4	0.5	0.6
<200	0.0	0.0	0.0	0.0	0.0

Deposit Number	45146	45152	45152	45152	45157
Sample Number	HB653	HG903A	HG903B	HB612	HG897
Crushable on Site	-	-	-	-	-
1 1/2 in.	100.0	91.8	91.5	84.1	100.0
3/4 in.	99.0	78.5	82.6	71.3	94.3
3/8 in.	96.4	64.5	76.9	57.9	83.3
#4	92.6	49.3	65.1	49.4	70.9
#8	82.5	31.8	54.3	42.7	55.2
#16	56.9	16.6	38.7	37.1	37.5
#30	21.9	8.6	21.5	27.4	23.8
#50	3.3	5.2	6.8	12.9	10.7
#100	1.1	3.4	2.9	5.7	2.9
#200	0.7	1.9	1.3	3.4	0.9
<200	0.0	0.0	0.0	0.0	0.0

Deposit Number	45160	45162	45163	45163	45166
Sample Number	HG899	HG900	HG901	HG904	HG905
Crushable on Site	x	x	-	x	-
1 1/2 in.	91.2	98.9	100.0	86.3	100.0
3/4 in.	80.1	92.3	95.6	73.3	100.0
3/8 in.	70.6	82.6	89.6	68.9	99.2
#4	59.8	74.5	77.2	64.3	95.1
#8	50.3	67.3	60.6	60.7	84.1
#16	40.5	56.9	41.1	52.7	65.2
#30	31.6	40.5	23.2	31.8	46.3
#50	19.3	15.5	10.9	5.1	32.6
#100	9.7	6.5	6.4	1.4	15.4
#200	4.0	2.6	3.4	0.7	3.9
<200	0.0	0.0	0.0	0.0	0.0

Deposit Number	45171	45172	45175	45178	45180
Sample Number	HG906	HG913	HG917	HG909	HG916
Crushable on Site	-	-	-	-	-
1 1/2 in.	96.8	100.0	100.0	99.4	100.0
3/4 in.	89.5	96.1	100.0	92.4	91.1
3/8 in.	79.6	82.8	95.2	84.8	85.6
#4	69.1	70.0	84.1	72.5	76.7
#8	53.0	61.4	59.1	53.2	63.3
#16	31.8	50.0	34.3	31.2	40.7
#30	12.7	35.8	13.3	13.4	18.2
#50	3.0	8.3	3.3	3.0	5.9
#100	1.3	1.0	1.4	1.2	2.5
#200	0.6	0.3	0.7	0.6	1.2
<200	0.0	0.0	0.0	0.0	0.0

Deposit Number	45181	45182	45183	45183	45186
Sample Number	HG879	HG862	HG880	HB552	HG866
Crushable on Site	-	x	x	-	-
1 1/2 in.	100.0	95.2	100.0	82.1	96.5
3/4 in.	94.6	86.9	98.3	65.3	89.1
3/8 in.	83.9	78.2	95.6	55.5	73.0
#4	74.8	67.7	85.8	48.0	57.9
#8	63.8	55.5	70.1	38.9	46.0
#16	50.4	42.7	52.0	30.0	35.8
#30	35.3	28.9	38.2	21.9	24.4
#50	16.2	18.4	13.5	11.5	10.4
#100	6.6	14.4	4.2	6.5	4.2
#200	2.6	10.2	2.2	5.1	2.8
<200	0.0	0.0	0.0	0.0	0.0

Deposit Number	45186	45188A	45188A	45188B	45188C
Sample Number	HB589	HG868	HB577	HG870	HB570
Crushable on Site	-	-	-	-	-
1 1/2 in.	96.4	86.9	93.4	97.0	92.1
3/4 in.	90.2	70.6	85.6	85.8	78.2
3/8 in.	84.2	57.8	77.0	71.6	65.5
#4	73.7	47.0	66.2	60.3	47.8
#8	62.2	34.1	55.9	51.8	30.1
#16	45.2	19.0	38.9	44.9	16.8
#30	24.9	10.4	13.9	37.5	11.0
#50	7.2	6.1	4.5	23.2	8.3
#100	3.9	4.0	2.8	8.6	6.5
#200	3.1	1.9	1.7	3.6	4.6
<200	0.0	0.0	0.0	0.0	0.0

Deposit Number	45189	45190A	45194B	45194B	45194B
Sample Number	HB581	HG875	HG860	HG911	HG912
Crushable on Site	x	-	-	-	-
1 1/2 in.	86.3	91.9	93.5	96.1	97.9
3/4 in.	71.7	78.9	76.2	76.3	85.9
3/8 in.	63.2	64.9	55.7	56.5	72.2
#4	53.1	51.8	38.4	40.0	62.5
#8	41.4	38.6	24.0	30.4	55.5
#16	24.7	28.0	14.1	23.7	48.6
#30	14.5	18.4	7.9	17.2	42.4
#50	9.5	10.4	4.7	10.3	27.4
#100	6.6	6.8	3.4	5.4	18.2
#200	4.2	4.0	1.9	2.7	9.2
<200	0.0	0.0	0.0	0.0	0.0

Deposit Number	45194B			
Sample Number	HB638	HG874	HG863	HG864
Crushable on Site	-	-	x	-
1 1/2 in.	91.8	100.0	96.1	100.0
3/4 in.	77.7	98.6	84.6	98.8
3/8 in.	66.2	91.0	74.6	91.9
#4	50.2	82.9	62.6	76.1
#8	34.8	72.8	51.9	52.6
#16	20.7	56.4	41.2	35.2
#30	10.4	30.7	28.3	24.1
#50	4.9	13.1	13.7	14.9
#100	3.1	3.9	5.3	6.1
#200	2.2	2.1	3.4	2.6
<200	0.0	0.0	0.0	0.0

Deposit Number					
Sample Number	HG869	HG871	HG872	HG873	HG882
Crushable on Site	-	x	x	-	
1 1/2 in.	93.6	95.5	91.9	88.4	100.0
3/4 in.	80.9	84.1	75.9	72.8	96.8
3/8 in.	68.3	69.3	57.5	60.7	91.9
#4	57.6	52.0	36.8	49.5	73.3
#8	47.7	36.0	20.6	41.2	38.6
#16	40.0	19.1	10.3	33.4	19.4
#30	32.3	8.0	5.9	23.8	14.0
#50	18.0	5.7	4.3	9.7	10.6
#100	6.9	4.2	3.0	3.5	4.2
#200	3.7	2.8	1.4	1.4	2.5
<200	0.0	0.0	0.0	0.0	0.0

APPENDIX B

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
45101	HG890s	pit 4 m deep, revegetated; silt and clay along south wall, 2 m fine pebble gravel along west wall. Cobbles on site.
45102	HG891	pit revegetated and depleted; some gravel remains at north end.
HG892s		pit 4 m deep; variable material that includes areas of till, clay, sand and gravel.
45103	HG887s	2 m sand with occasional fine gravel beds.
45105	HG886	deposited against bedrock; pit is 12 m high, slumped and revegetated; upper 2 m is variable sand and pebble gravel; lower 10 m, covered, is primarily fine sand and silt.
45106	HG885s	pit is small, intermittent usage
		0.0 - 1.0 m sandy fine pebble gravel
		1.0 - 1.5 m coarse sand, fine pebbles
		1.5 - 2.0 m scree
		- fine sand at base
45110	HG896s	large pit, recently active. Material overlies bedrock and is of varying thickness and coarseness
		0.0 - 4.0 m sandy coarse gravel with cobbles
		- backhoe testhole at base of pit
		4.0 - 4.5 m coarse sand
		4.5 - 5.5 m pebble gravel
		5.5 - 8.0 m+ cobble gravel
	HB597	0.0 - 1.5 m coarse sand, some pebbles and granules
		1.5 - 3.0 m fine sand
	HB598	0.0 - 2.0 m+ medium sand
45113	HB599	0.0 - 2.0 m very sandy, fine pebble gravel
		2.0 - 3.5 m coarse sand
		- bedrock
45114	HG876	pit depleted; 2 - 3 m deep; fine nd and granule pockets remaining
45115	HG888	pit revegetated, near depletion; 1 - 2 m sandy coarse pebble gravel at south end, silts at north end
45117	HG889	pit beginning to revegetate; primarily fine sand, some gravel pockets
45118	HG894s	pit up to 10 m high, flanking bedrock; pockets of coarse cobble gravel, pebble gravel, sand and silt
	HG907	variable material; more clay than HG894, little gravel remains
45120	HG908	0.0 - 0.8 m silt and clay-rhythmites
		0.8 - 2.0 m medium fine sand - yellow
		2.0 - 3.0 m scree
45126	HB615	0.0 - 0.3 m coarse sand - oxidized, cobble lag at base
		0.3 - 2.5 m+ medium sand - grey; isolated cobbles and pebbles throughout
45127	HG898s	pit not in recent use - material flanksbedrock; very coarse pebble gravel with cobbles down 5 m high exposure
45128	HG858	backhoe pit
		0.0 - 3.0 m medium sand, occasional beds of pebbly sand
		- caving

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
45130	HG884s	large active pit
		0.0 - 0.2 m coarse pebble gravel
		2.0 - 4.0 m+ sandy fine pebble gravel
	HB627s	0.0 - 1.0 m sandy coarse pebble gravel
		1.0 - 3.0 m sandy fine pebble gravel
		3.0 - 6.0 m+ very sandy coarse pebble gravel with cobbles
	HB628s	0.0 - 2.6 m very sandy pebble gravel
		2.6 - 3.5 m+ coarse sand
	HB629	0.0 - 1.5 m very sandy fine pebble gravel
		1.5 - 4.0 m+ pebbly sand
	HB630	0.0 - 2.0 m coarse sand, cobble lag at base
		2.0 - 3.2 m coarse sand
		3.2 - 3.5 m sandy fine pebble gravel
		- caving
45133	HG883s	roadside pit 4 m deep, recently active; material primarily sandy pebble gravel but areas of cobble gravel and granules
45141	HG914s	pit flanking bedrock; no recent use. Pit, 5 m high, is of variable, predominantly coarse material.
45145	HB600	0.0 - 1.0 m medium sand, oxidized
		1.0 - 3.5 m+ granules and coarse sand
45146	HG902s	pit, intermittent use, recently in use
		0.0 - 3.0 m sandy coarse pebble gravel with cobbles
	HB603s	0.0 - 1.0 m sandy fine pebble gravel
		1.0 - 3.5 m+ coarse sand, some stone
	HB604	0.0 - 2.0 m coarse sand
		- caving
	HB605	0.0 - 3.0 m+ medium sand; gravel lag at surface
	HB653s	active pit, 6 m deep - very sandy fine pebble gravel (most in granule size range); less than 1 m sandy coarse pebble gravel at surface
45147	HG877	depleted pit; less than 2 m gravel over bedrock
45151	TP084	0.0 - 1.5 m sandy coarse pebble gravel
		1.5 - 2.5 m sandy fine pebble gravel, cobbles at base
		2.5 m+ - till
	HB606	0.0 - 1.4 m sandy pebble gravel
		1.4 - 3.0 m+ coarse sand, some granules and pebbles
	HB607	0.0 - 1.1 m coarse sand, oxidized, some pebble beds at base
		1.1 - 2.9 m+ medium fine sand
	HB608	0.0 - 0.8 m coarse sand, oxidized
		0.8 - 1.5 m fine sand, grey
		1.5 - 4.0 m+ pebbly sand
45152	HG903s	large pit, intermittent usage
		0.0 - 1.0 m sandy coarse pebble gravel
		1.0 - 3.0 m granules, some sand beds
		3.0 - 4.5 m coarse sand, some pebbles
		4.5 - 5.5 m sandy coarse pebble gravel
		- water table

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
	HB610	0.0 - 0.5 m coarse sand
		0.5 - 2.5 m+ thin bed silty clay over sand that fines downward
	HB611	0.0 - 0.5 m coarse sand, pebble lag at surface
		0.5 - 1.0 m silt - stone free
		1.0 - 2.0 m granules - coarser to base
		- water table
	HB612s	0.0 - 1.0 m sandy coarse pebble gravel with cobbles
		1.0 - 3.0 m+ sand, some pebble beds
	HB634	0.0 - 1.8 m fine sand
		1.8 - 3.0 m coarse sand
	HB635	0.0 - 1.0 m sandy coarse pebble gravel
		1.0 - 2.5 m+ interbedded fine sand and pebbly sand
	TP085	0.0 - 0.8 m sandy coarse pebble gravel with cobbles
		0.8 - 1.5 m fine sand
		1.5 - 2.0 m pebbly sand
		2.0 m+ - till
45153	HB613	0.0 - 3.2 m sand, fines downward but granule bed at base
	HB614	0.0 - 1.5 m coarse sand and granules
		- water table at 1.0 m
	HB615	0.0 - 0.3 m coarse sand; cobble layer
		0.3 - 2.8 m medium sand, isolated pebbles and cobbles throughout
	HB633	0.0 - 1.0 m sand
		1.0 m+ - till
45155	HB632	0.0 - 1.1 m coarse sand
		1.1 - 2.5 m fine sand
		- water table
45157	HG897s	pit less than 2 m deep - limited by water table; very sandy fine pebble gravel
45160	HG899s	4 m deep pit flanking bedrock; upper metre diamicton, lower 3 m sandy pebble gravel with cobbles
45161	HB616	0.0 - 0.8 m coarse sand and granules
		0.8 - 3.5 m medium sand
	HB617	0.0 - 0.3 m coarse sand, oxidized
		0.3 - 1.4 m fine sand
		- caving
45162	HG900s	pit, 3.5 m deep, used intermittently, variable material from silt through cobble gravel
	HB618	0.0 - 0.9 m sandy coarse pebble gravel
		0.9 - 3.0 m+ medium sand
	HB619	0.0 - 0.8 m sand, oxidized
		0.8 - 1.5 m interbedded fine sand and silt
		- water table
45163	HG901s	active pit; 2 m sandy fine pebble gravel above water table
	HG904s	0.0 - 2.4 m sandy fine pebble gravel
		2.4 - 3.4 m medium sand
		3.4 - 4.3 m+ sandy pebble gravel

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
	HB620	small pit
		0.0 - 1.5 m sand/pebble gravel/granules
		backhoe at base
		1.5 - 3.0 m medium fine sand; silty at base
		3.0 - 3.9 m sandy coarse pebble gravel
		3.9 - 4.2 m fine sand
		- water table
	TP086	0.0 - 0.6 m coarse sand, oxidized
		0.6 - 1.5 m pebbly sand
		1.5 - 3.3 m medium sand, some pebbles to base
		3.3 m+ - till
45165	HB621	0.0 - 0.3 m coarse sand, oxidized - lag gravel at surface
		0.3 - 2.8 m sand, fines downward, gravel layer at base
		- bedrock
	HB622	0.0 - 0.5 m medium sand, oxidized
		0.5 - 2.0 m coarse sand
		- caving
	HB623	0.0 - 1.3 m medium sand; cobble layer at base
		1.3 - 3.0 m+ fine sand, coarsens downward
45166	HG905s	roadcut
		0.0 - 1.0 m sandy fine pebble gravel fining to coarse sand
		1.0 - 1.8 m interbedded fine sand and silt
		1.8 - 2.5 screen
		- fine sand and silt
45171	HG906s	pit, 3 to 5 m deep, intermittent use; material variable from silty clay through cobble beds
45172	HG913s	pit, beginning to revegetate; 4 to 5 m sandy pebble gravel
45175	HG917s	rail line cut; 2 m interbedded coarse sand and fine pebble gravel
45177	HB593	0.0 - 1.0 m medium sand, oxidized
		- bedrock
	HB594	0.0 - 0.6 m sand
		0.6 - 0.9 m gravel lag
		0.9 - 1.6 m interbedded sand and granules
		1.6 - 2.9 m granules, silt lenses
		- water table
	HB595	0.0 - 0.6 m medium coarse sand, oxidized
		0.6 - 2.5 m fine sand, some silt beds at base
		2.5 - 3.0 m granules
		- water table
	HB596	0.0 - 1.0 m interbedded sand and granules
		1.0 - 3.0 m fine sand, coarsens downward
		- water table
	HB636	0.0 - 0.3 m fine sand
		0.3 - 2.7 m granules, silt bed, coarse sand
		2.7 - 2.8 m granules and coarse sand
		- water table

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
	HB637	0.0 - 0.3 sand, oxidized; cobble lag
		0.3 - 2.5 m fine sand; silt laminae
		- water table
45178	HG909s	active pit, 7 m deep, upper unit (1 - 3 m thick) is predominantly sand; lower unit is interbedded sand, fine pebble gravel and granules
45179	HG881	pit, intermittent usage; 5 - 8 m deep; variable material, predominantly sand, some gravel areas
45180	HG916s	shallow pit, near depletion, predominantly sandy fine pebble gravel
45181	HG878	abandoned pit
		0.0 - 0.5 m coarse sand and granules
		0.5 - 1.0 m interlaminated silt and fine sand
		1.0 - 2.2 m+ rhythmically bedded fine sand and silty fine sand
	HG879s	abandoned pit; 3 m pebbly sand with occasional beds fine pebble gravel
45182	HG862s	abandoned pit; 2.5 m sandy pebble gravel; till floored
45183	HG880s	pit, intermittent use; 2 - 3 m pebble gravel; water table at base
	HB550	pit wall
		0.0 - 3.0 m pebble gravel, some cobbles backhoe at base
		3.0 - 4.0 m pebble gravel into sand
		4.0 - 5.5 clay, some stone
	HB551	0.0 - 0.6 m coarse sand
		0.6 - 1.5 m+ - till
	HB552	0.0 - 2.5 m sandy coarse pebble gravel
		2.5 - 2.7 m+ - clay
	HB555	0.0 - 2.0 m sandy fine pebble gravel
		2.0 - 2.5 m coarse sand
		2.5 - 2.6 m+ - clay
45184	HB553	0.0 - 2.5 m sandy pebble gravel with cobbles
		- caving
	HB554	0.0 - 1.2 m fine sand, pebbly at base
		1.2 - 2.0 m+ clay, stoney
45185	HB557	0.0 - 0.7 medium sand, oxidized
		0.7 - 0.8 m+ clay
	HB558	0.0 - 0.1 m sandy fine pebble gravel
		1.0 - 2.0 m clayey silt
		- till
	HB559	0.0 - 0.8 m sandy fine pebble gravel
		0.8 - 3.8 m+ medium fine sand, siltier at base
	HB560	0.0 - 0.9 m fine pebble gravel
		0.9 - 3.5 m+ medium fine sand
45186	HG866s	0.0 - 1.5 m sandy fine pebble gravel
		1.5 - 2.0 m cobbles
		- till
	HB562	base of depleted pit
		0.0 - 0.8 m sandy fine pebble gravel
		0.8 - 1.3 m+ silt

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
	HB588	0.0 - 1.3 m coarse sand, granules
		1.3 - 2.0 m+ medium sand
	HB589s	0.0 - 1.5 m sandy pebble gravel
		1.5 - 2.0 m+ medium sand
	HB589A	0.0 - 0.6 m medium sand
		0.6 - 1.8 m sandy pebble gravel
		1.8 - 2.3 m+ clay
	HB590	0.0 - 0.1 m sand, oxidized
		0.1 - 1.8 m sandy fine pebble gravel
		1.8 - 2.0 m+ silt
		- water table
	HB591	0.0 - 1.8 m medium sand
		1.8 - 2.6 m sandy fine pebble gravel
		2.6 - 2.9 m+ silty clay
	HB592	0.0 - 0.4 m medium sand
		0.4 - 1.5 m sandy fine pebble gravel
		1.5 - 1.7 m+ silt
	TP078	base of depleted pit
		0.0 - 0.9 m sandy coarse pebble gravel
		- till
	TP082	0.0 - 0.4 m sand
		0.4 - 0.6 m granules, coarsens to pebble gravel at base
		0.6 - 1.3 m+ till
	TP083	0.0 - 0.5 gravel lag
		0.5 - 2.0 m+ till
45187	HB574	0.0 - 0.3 m sandy fine pebble gravel
		0.3 - 3.0 m fine sand
		- till
	HB575	0.0 - 0.3 m sandy fine pebble gravel
		0.3 - 3.2 m fine sand
		- till
45188A	HG868s	pit, intermittent use
		0.0 - 2.0 m sandy coarse pebble gravel
		2.0 - 3.0 m coarse sand, coarsens downward
		to sandy fine pebble gravel at base
		3.0 - 3.3 m fine sand
		3.3 - 5.3 m sandy fine pebble gravel
		- water table
	HB576	0.0 - 3.0 m+ coarse pebble gravel
	HB577s	0.0 - 2.8 m sandy fine pebble gravel
		2.8 - 3.1 m+ fine sand
45188B	HG870	pit, intermittent use; 3 - 6 m sandy pebble gravel; pit floor is 0.8 m fine sand over silty clay
	HG870A	0.0 - 1.2 m sandy coarse pebble gravel
		1.2 - 22 m interbedded medium sand and sandy fine pebble gravel
		2.2 - 3.0 m+ medium fine sand

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
	HB565	0.0 - 1.6 m sandy fine pebble gravel
		1.6 - 2.0 m+ fine sand
	HB568	0.0 - 0.6 m medium sand, oxidized
		0.6 - 1.2 m sandy fine pebble gravel
		1.2 - 2.0 m+ fine sand
	HB569	0.0 - 1.0 m sandy coarse pebble gravel
		1.0 - 1.3 m sand
		1.3 - 2.3 m sandy coarse pebble gravel
		2.3 - 3.8 m+ fine sand
45188C	HB564	0.0 - 0.3 m sand, oxidized
		0.3 - 2.1 m+ fine sand
	HB566	0.0 - 0.6 m coarse sand
		0.6 - 2.0 m+ medium sand
	HB570s	0.0 - 1.0 m medium fine sand
		1.0 - 3.0 m+ sandy pebble gravel
		- water table
	HB571	0.0 - 3.0 m+ sand, coarsens downward
	HB572	0.0 - 0.5 m sandy coarse pebble gravel
		0.5 - 1.5 m+ medium fine sand
	HB573	0.0 - 0.5 m sandy fine pebble gravel
		0.5 - 1.5 m fine sand
		- bedrock
	HB567	0.0 - 0.2 m coarse sand
		0.2 - 0.5 m sandy fine pebble gravel
		0.5 - 1.5 m pebbly sand
		- boulder
45189	HB581s	0.0 - 0.3 m coarse sand, oxidized
		0.3 - 1.0 m clay
		1.0 - 3.8 m+ coarse gravel, cobbles
	HB582	0.0 - 1.0 m medium sand, oxidized
		1.0 - 3.0 m+ coarse pebble gravel
	HB583	0.0 - 0.7 m coarse sand, oxidized
		0.7 - 1.6 m clay
		1.6 - 3.0 m+ cobbles, sand, silt
	HB583A	0.0 - 0.3 m sand
		0.3 - 1.3 m interbedded sand and granules
		1.3 - 1.7 m+ clay and silt
45190A	HG875s	pit, 4 m deep, no recent use; sandy pebble gravel with some cobbles
	HB578	0.0 - 1.0 m medium coarse sand
		1.0 - 2.8 m granules and coarse sand
		2.8 - 3.1 m+ medium sand
	HB579	0.0 - 1.5 m sandy coarse pebble gravel
		- bedrock
	HB580	0.0 - 0.4 m lag gravel
		0.4 - 1.2 m medium to coarse sand
		1.2 - 2.0 m interbedded granules and sand
		2.0 - 2.5 m+ medium sand

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
45190B	HB584	0.0 - 1.5 m medium-fine sand
		- bedrock
	HB585	0.0 - 1.0 m sandy fine pebble gravel
		1.0 - 3.0 m+ medium sand
	HB586	0.0 - 1.5 m coarse pebble gravel
		1.5 - 2.0 m clay
		- till
	TP081	0.0 - 0.5 m cobble lag
		0.5 - 1.5 m silt and clay, stony
		1.5 - 1.6 m till
		1.6 - 1.8 m+ silt and clay, stony
45191	HB587	0.0 - 3.0 m interbedded sand and granules
		- caving
45192	HG910	small pit, intermittent use
		0.0 - 0.5 m sandy pebble gravel
		0.5 - 2.3 m+ medium sand
45194A	HB642	0.0 - 0.1 m sand
		0.1 - 0.9 clay, stony
		0.9 - 1.0 m sand
		1.0 - 1.9 m+ till
	HB643	0.0 - 2.9 m sand, coarsens downward
		2.9 - 3.1 m silty sand
		3.1 - 3.3 m fine pebble gravel
		3.3 - 3.5 m+ silt
	HB645	0.0 - 1.2 m medium-fine sand, oxidized
		1.2 - 2.0 sand
		2.0 - 2.3 m+ till
	HB646	0.0 - 1.5 m fine sand
		- till
	HB647	0.0 - 0.2 m sand, oxidized
		0.2 - 1.8 m medium fine sand
	HB648	0.0 - 0.5 m sand, oxidized
		0.5 - 1.0 m silty clay
		1.0 - 2.0 fine sand
		2.0 - 2.4+ m till
	HB649	0.0 - 1.0 m sand
		1.0 - 1.6 m sandy fine pebble gravel
		1.6 - 1.9 m+ till
45194B	HG860s	large pit, recent use
		0.0 - 1.5 m sand
		1.5 - 3.0 m+ pebble gravel
		- water table
	HG911s	0.0 - 1.0 m sand
		1.0 - 2.5 m+ pebble gravel
		- water table
	HG912s	large pit, 3 m to water table; very sandy pebble gravel

Backhoe Test Pit Logs and Gravel Pit Descriptions

DEPOSIT	SITE s = sample	SITE DESCRIPTION
	HB638s	0.0 - 0.8 m coarse sand, oxidized
		0.8 - 1.3 m interbedded sand and granules
		1.3 - 2.2 m+ pebble gravel
		- water table
	HB638A	0.0 - 0.7 m coarse sand, oxidized
		0.7 - 3.0 m+ coarse sand
	HB639	0.0 - 2.1 m pebble gravel
		2.1 - 3.3 m sand
		- water table
	HB644	0.0 - 0.6 m sand, oxidized
		0.6 - 2.8 m medium sand
		2.8 - 3.9 m+ sandy fine pebble gravel
	HB644A	0.0 - 0.8 m lag gravel
		0.8 - 1.5 m fine sand
45194C	HB640	0.0 - 1.0 m sandy coarse pebble gravel
		- till
	HB641	small pit
		0.0 - 0.2 m sandy coarse pebble gravel
		- till

APPENDIX C

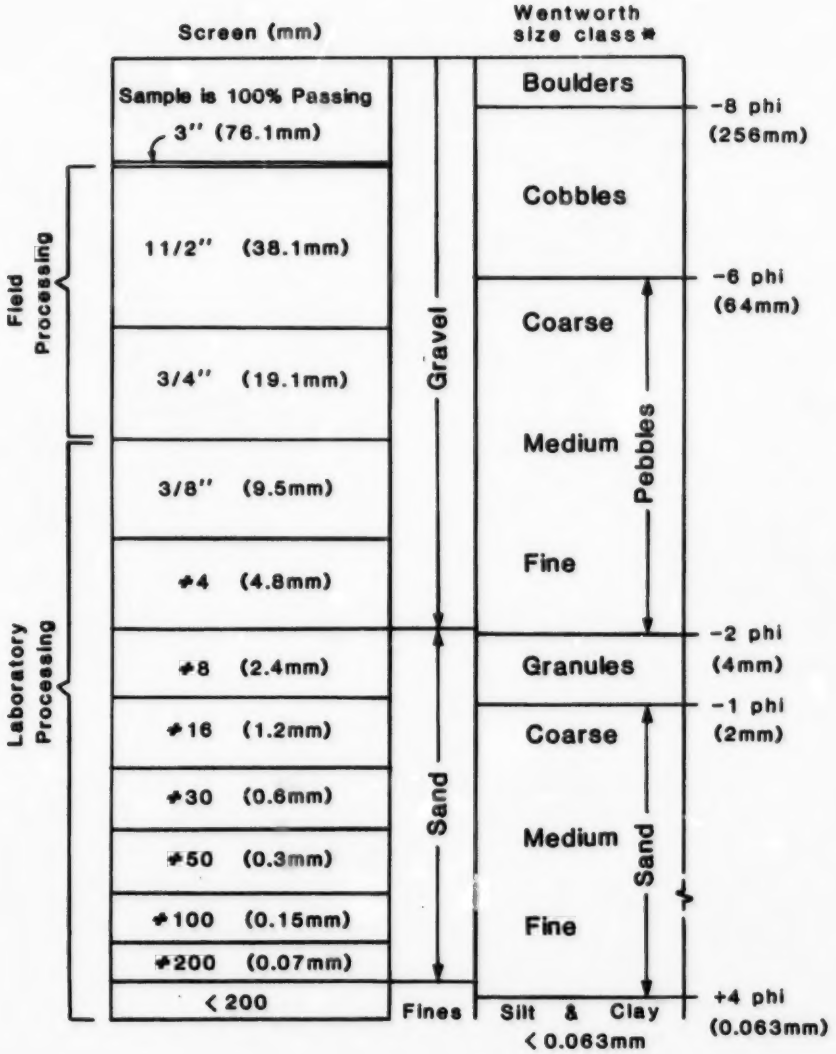
Pebble Lithology and Deleterious Content of Samples

Deposit Number	Sample Number	% Lithology Precambrian Intrusive	Precambrian Volcanic	Precambrian Meta-morphic	Paleozoic Carbonate	% Deleterious
45101	HG890	17	83	-	-	0.5
45102	HG892	27	73	-	-	-
45103	HG887	29	71	-	-	-
45106	HG885	50	49	1	-	1.0
45110	HG896	45	55	-	-	0.8
45118	HG894	55	45	-	-	-
45127	HG898	27	73	-	-	-
45130	HG884A	39	61	-	-	-
	HG884B	42	57	1	-	1.0
	HB627	84	15	1	-	6.0
	HB628	70	9	1	-	3.4
45133	HG883	45	55	-	-	-
45141	HG914	88	8	4	-	4.7
45146	HG902	44	55	1	-	2.7
	HB603	64	36	-	-	1.8
	HB653	71	29	-	-	-
45152	HG903A	58	29	13	-	3.6
	HG903B	75	24	1	-	2.0
	HB612	39	61	-	-	0.4
45157	HG897	38	61	1	-	1.0
45160	HG899	22	78	-	-	-
45162	HG900	31	69	-	-	-
45163	HG901	43	57	-	-	-
	HG904	46	37	17	-	4.3
45166	HG905	59	39	2	-	4.6
45171	HG906	38	59	3	-	4.0
45172	HG913	87	12	1	-	0.7
45175	HG917	100	-	-	-	-
45178	HG909	59	38	3	-	6.0
45180	HG916	93	7	-	-	8.9
45181	HG879	54	36	6	4	6.0
45182	HG862	52	47	1	-	1.4
45183	HG880	73	16	7	4	4.0
	HB552	37	32	2	29	3.1
45186	HG866	3	2	-	95	0.7
	HB589	11	4	-	85	0.6
45188A	HG868	8	2	-	91	0.8
	HB577	7	3	-	90	-
45188B	HG870	15	7	-	78	0.8
45188C	HB570	28	13	-	59	1.7
45189	HB581	28	63	3	6	6.8
45190A	HG875	21	67	6	6	8.4

Deposit Number	Sample Number	% Lithology: Precambrian Intrusive	Precambrian Volcanic	Precambrian Metamorphic	Paleozoic Carbonate	% Deleterious
45194B	HG860	3	5	1	91	4.0
	HG911	9	29	-	62	4.3
	HG912	13	56	-	31	39.3
	HB638	4	8	-	88	2.8

APPENDIX D

Grain Size Classification



* modified from Folk, 1974

APPENDIX E

Glossary

AGGREGATE

Any inert, construction material (sand, gravel, slag, crushed stone or other mineral material).

AGGREGATE RESERVES

Aggregate in a deposit which is proven and is economically signficiant.

ALLUVIUM

Alluvium is a general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during postglacial time by a stream.

BEACH DEPOSITS

These are relatively narrow, linear features formed at the shores of glacial lakes that existed during deglaciation. Well developed beaches are usually less than 20 feet (6 m) thick. The aggregate is well sorted and stratified and sand-sized material commonly predominates.

BEDROCK

In-place pre-Quaternary material exposed at the surface or underlying the surficial material.

BINDER

Material that produces or promotes consolidation in loosely aggregated sediments. Usually mud or clay, sometimes till is used for binder.

CARBONATE ROCKS

A broad term referring to those sedimentary rocks consisting chiefly of carbonate minerals, mainly limestone and dolostone.

CLAST

An individual constituent, grain, or fragment of a sediment or rock, produced by the mechanical weathering of a large rock mass. Synonyms include particle and fragment.

CROWN LAND

Land reserved and administered by the Crown. Sand and gravel usually administered by the Crown.

CROWN SAND AND GRAVEL

Sand and gravel reserved and administered by the Crown.

DELETERIOUS LITHOLOGY

A general term used to designate those rock types which are chemically or physically unsuited for use as construction or road-building aggregates. Such lithologies as chert, shale, siltstone, and sandstone may deteriorate rapidly.

DEPOSIT

An accumulation of sediments left in a new location by a natural transportative agent such as water, wind, ice, or gravity.

An aggregate deposit is a deposit of sand and gravel considered to be of economic significance.

DIRT

See fines.

DOLOMITE (DOLOSTONE)

A carbonate sedimentary rock consisting chiefly of the mineral dolomite and containing relatively little calcite (dolomite is also known as dolostone).

DRIFT

A general term for all unconsolidated rock debris transported from one place and deposited in another; distinguished from underlying bedrock. In North America, glacial activity has been the dominant mode of transport and deposition of drift. Synonyms include overburden and surficial deposit.

DURABLE ROCK

A rock fragment which is hard and inert and can be used as aggregate without breaking, crumbling or reacting with the cementing material.

EOLIAN

Pertaining to wind action.

EPOCH

A geological-time unit longer than an age and a subdivision of a period.

ESKERS

Eskers are narrow, sinuous ridges of sand and gravel. They vary greatly in size. Many eskers consist of a central core of poorly sorted and stratified gravel. The core material is often draped by better sorted and stratified sand and gravel.

FINES

A general term used to describe the size fraction of an aggregate which passes (is finer than) the No. 200 mesh screen (0.074 mm). Also described informally as "dirt", these particles are in the silt- and clay-size range.

FLUVIAL

Pertaining to rivers or streams.

GLACIOFLUVIAL DEPOSITS

Material deposited by streams flowing from, on, or within melting glacier ice, generally composed of sorted, stratified sand and gravel; includes outwash, kame, esker, etc.

GLACIOLACUSTRINE DELTAS

These features were formed where streams or rivers of glacial meltwater flowed into lakes and deposited their suspended sediment. Such deposits tend to consist mainly of sand and abundant silt. However, in near-ice or ice-contact positions, coarse material may be present.

GLACIOLACUSTRINE DEPOSITS

Material deposited in lakes affected by glacier ice or by meltwater flowing directly from glaciers; composed of well-sorted clay, silt, or sand.

GRANULAR BASE COURSE

Components of a road placed on subgrade and designed to provide strength, stability, and drainage, as well as support for surfacing materials. Several types have been defined: Granular Base Course A consists of crushed and processed aggregate and has relatively stringent quality standards in comparison to Granular Base Course B and C which are usually pit-run or other unprocessed aggregate.

GROUND MORAINE

A deposit of till with a flat or undulating surface.

HOLOCENE

An epoch of the Quaternary period covering the time period from the retreat of the continental glaciers to the present, about 10 000 years.

HUMMOCKY

An irregular or knob and kettle surface.

HUMMOCKY MORAINE

A landscape composed primarily of till with a hummocky surface.

ICE-CONTACT DEPOSIT

Material deposited in contact with glacier ice by meltwater; includes kames, eskers, kame terraces, etc.

ICE-CONTACT TERRACES

These are glaciofluvial features deposited between the glacial margin and a confining topographic high, such as the side of a valley. The structure may be similar to outwash deposits.

KAMES

Kames are mounds of poorly sorted sand and gravel deposited by meltwater in depressions or fissures on the ice surface or at its margin. The deposits consist mainly of irregularly bedded and cross-bedded, poorly sorted sand and gravel. Deposits include single mounds, linear ridges (crevasse fillings) or complex groups of landforms.

LACUSTRINE DEPOSIT

Material deposited in a lake.

LITHOLOGY

The description of rocks on the basis of such characteristics as color, structure, mineralogic composition, and grain size. Generally, the description of the physical character of a rock.

MELTWATER CHANNEL

A drainage way produced by water flowing away from a melting glacier margin.

MORAINE

A distinct accumulation of glacial drift. Could represent an ice marginal position.

OUTWASH

Outwash deposits consist of sand and gravel laid down by meltwaters beyond the margin of the ice lobes. They occur as sheets or as terraced valley fills (valley trains) and may be very large in extent and thickness. Well developed outwash deposits have good horizontal bedding and are uniform in grain-size distribution. Outwash deposited near the glacier's margin is much more variable in texture and structure.

PIT RUN

Unprocessed aggregate removed from pit. Generally consists of fine pebble gravel with minor amounts of material coarser than 38 mm (1 1/2"). It is used for road maintenance, upgrading and resurfacing.

PLEISTOCENE

An epoch of the recent geological past including the time from approximately 1.8 million years ago to 10 000 years ago. Much of the Pleistocene was characterized by extensive glacial activity.

QUATERNARY

The second period of the Cenozoic era, thought to cover the last 2-3 million years. It consists of two epochs: The Pleistocene and the Holocene.

RESOURCE

An aggregate deposit or environment which may or may not be proven and is presently not economically significant.

SHALE

A fine-grained, sedimentary rock formed by the consolidation of clay, silt, or mud and characterized by well developed bedding planes, along which the rock breaks readily into thin layers. The term shale is also commonly used for fissile claystone, siltstone, and mudstone.

SPILLWAY

Large drainage valley formed by meltwater flowing from a glacial lake. Spillways often have gravel terraces.

STERILIZED

Term indicating deposit is unavailable for gravel extraction - usually due to a cultural factor such as having a building or road located on the deposiit.

STONE

That component of aggregate coarser than 4.76 mm or the #4 sieve, includes pebbles, cobbles and boulders.

SURFICIAL GEOLOGY

A form of geological mapping dealing with all materials occurring at surface in an area: unlithified or lithified (sediments or bedrock).

TERRACE

A relatively flat, stair-stepped, depositional or erosional surface bounded by an ascending slope on one side and a descending slope on the other.

TILL

Unsorted and unstratified rock debris, deposited directly by glaciers, and ranging in size from clay to large boulders.

WISCONSINAN

Pertaining to the last glacial stage of the Pleistocene Epoch in North America. It began approximately 100 000 years ago and ended approximately 10 000 years ago. The glacial deposits and landforms of southern Manitoba are predominantly the result of glacial activity during the Winsconsinan Stage.

MAPS
NOT
FILMED

CARTES
OMISES